

A new species of *Hemidactylus* Goldfuss, 1820 (Squamata, Gekkonidae) from the Northern Eastern Ghats, Odisha, India

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Abstract

We describe a new species of large-bodied, rock-dwelling gecko of the genus *Hemidactylus* from the Eastern Ghats of Odisha, India. The new species is genetically distinct, as already indicated in previous studies, and differs from all other congeners in a combination of morphological characters, such as dorsal scalation of small granules intermixed with large, pointed, trihedral tubercles that form 15–19 fairly regularly arranged longitudinal rows at midbody; 9–11 subdigital lamellae below the first and 12–14 below the fourth digit; 22–26 femoral pores separated by five poreless scales in males; and 11–13 supralabials and 9–11 infralabials. The new species is from the Eastern Ghats clade of large-bodied, tuberculated *Hemidactylus* and can be readily diagnosed morphologically from the two sister species, *H. sushilduttai* and *H. kangerensis*, in having characters such as the second postmental distinct and ~70% of the first postmental; the first postmental touching infralabial I and the second postmental touching infralabials I and II; and one post-cloacal spur on each side. The new species is distributed in the northern Eastern Ghats range of Odisha, inhabiting moist and dry deciduous forests and rock boulders and occasionally entering human habitations.

Key Words

Deccan Peninsula, Eastern Highlands, *Hemidactylus kangerensis*, *Hemidactylus sushilduttai*, morphology, taxonomy

Introduction

Hemidactylus Goldfuss, 1820, is one of the most speciose genera among gekkonids, with 198 described species, of which 60 are distributed in India (Sayyed et al. 2025; Uetz et al. 2025). These geckos are of medium to large size, inhabiting varied habitat types ranging from terrestrial to arboreal. They are adapted to live below logs or boulders, in

caves, on trees, and in rock crevices, and some of them are human commensals. Since 2008, there have been several studies on the systematics and phylogeny of this genus, which have unravelled the cryptic diversity in the genus to a greater extent, with the description of 39 species (Giri 2008; Giri and Bauer 2008; Giri et al. 2009, 2017; Mahony 2009; Agarwal et al. 2011, 2019, 2020; Mirza and Sanap 2014; Dandge and Tiple 2015; Murthy et al. 2015; Mirza

and Raju 2017; Mirza et al. 2017, 2018; Chaitanya et al. 2018, 2019; Mirza 2018; Srikanthan et al. 2018; Srinivasulu et al. 2018; Khandekar et al. 2020, 2021, 2023; Lajmi et al. 2020; Adhikari et al. 2022; Das et al. 2022; Kumar et al. 2022; Pal and Mirza 2022; Mohapatra et al. 2023; Narayanan et al. 2023; Sayyed et al. 2023, 2025). However, many more species are still awaiting discovery, which is evident from the rate of new species discoveries post-2008.

As per our present understanding, the *H. prashadi* group is the most species-rich group under the Indian radiation of the genus *Hemidactylus*, comprising 23 described species (Giri 2008; Agarwal et al. 2011, 2019; Mirza and Sanap 2014; Giri et al. 2017; Mirza et al. 2017, 2018; Chaitanya et al. 2018; Srikanthan et al. 2018; Srinivasulu et al. 2018; Khandekar et al. 2020, 2021; Das et al. 2022; Pal and Mirza 2022; Mohapatra et al. 2023; Sayyed et al. 2023). The northern Western Ghats clade of this group, comprising *H. aaronbaueri* Giri, 2008, and *H. tamhiniensis* Khandekar, Thackeray & Agarwal, 2021, has been separated from the remaining species by a basal split. The remaining species are divided into two major clades: one is the northern clade (which includes species that are distributed mainly north of 14°N), and the other is the southern clade (with species largely distributed south of 13°N; Agarwal et al. 2019; Khandekar et al. 2021). The northern clade includes *H. prashadi* Smith, 1935; *H. maculatus* Duméril & Bibron, 1836; *H. siva* Srinivasulu, Srinivasulu & Kumar, 2018; the *H. triedrurus* complex (including *H. triedrurus* (Daudin, 1802); *H. sahgalii* Mirza, Gowande, Patil, Ambekar & Patel, 2018; *H. whitakeri* Mirza, Gowande, Patil, Ambekar & Patel, 2018; and *H. paucifasciatus* Mohapatra,

Agarwal, Mohalik, Dutta & Khandekar, 2023); and the northern Eastern Ghats group with two described species, *H. kangerensis* Mirza, Bhosale & Patil, 2017 from Chhattisgarh and *H. sushilduttai* Giri, Bauer, Mohapatra, Srinivasulu & Agarwal, 2017 from northern Andhra Pradesh.

Mohapatra et al. (2023) indicated a distinct, undescribed species of large-bodied, tuberculate *Hemidactylus* sp. belonging to the northern Eastern Ghats group from Kalinga Ghati, Kandhamal district, Odisha, India, based on the protein-coding ND2 gene (mitochondrially encoded NADH dehydrogenase 2), having GenBank Accession Number [MK569846](#), which we describe in this study as a novel species.

Materials and methods

Morphological and meristic data

Morphological data were collected from six specimens of this new species. The animals were collected from outside protected areas in Kandhamal, Khordha, Ganjam, and Angul districts of Odisha (Fig. 1) by hand and were euthanised with halothane following ethical guidelines for animal euthanasia (Leary et al. 2013). Tissue from the liver was collected in molecular-grade ethanol (Merck) for molecular work. The specimens were fixed in 8% formaldehyde solution by injecting the solution into the body and were later stored in 70% ethanol after overnight soaking in the formaldehyde solution. All specimens were deposited in the Reptilia section of the Zoological Survey

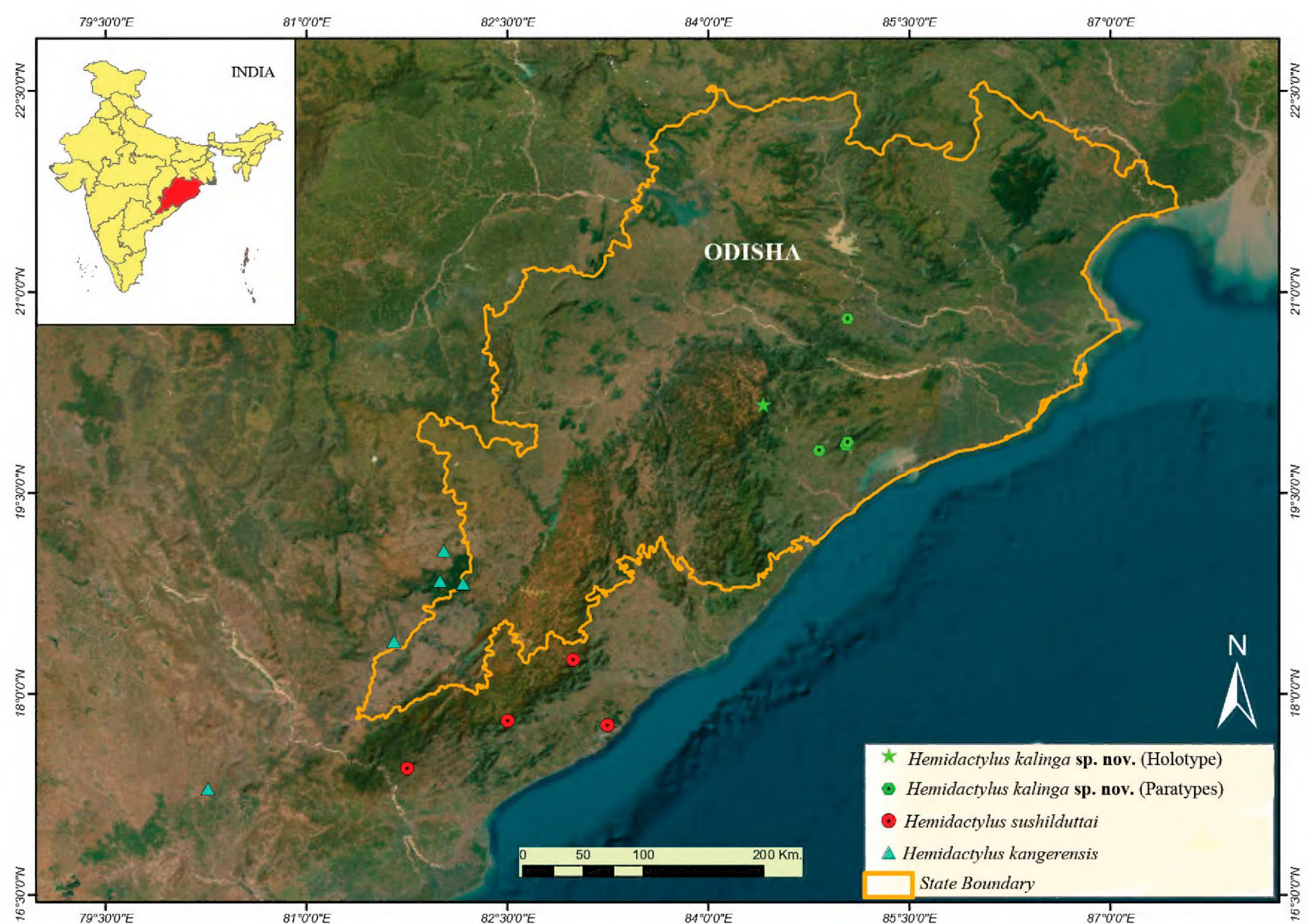


Figure 1. Distribution map showing the localities of the members of the *Hemidactylus sushilduttai* subclade in the northern Eastern Ghats, including *Hemidactylus kalinga* sp. nov.

of India, Kolkata (ZSI-R). Comparative data on described species of *Hemidactylus* spp. from peninsular India were taken from the literature on descriptions and comparisons of the congeners (Batuwita and Pethiyagoda 2012; Mirza et al. 2017; Srinivasulu et al. 2018; Srikanthan et al. 2018; Mohapatra et al. 2023). Comparisons were restricted to the species in the *H. prashadi* group. Mensural and meristic data were taken using a Leica EZ4 stereo dissecting microscope on the right side of the body where possible. Colouration was recorded from photographs taken in life. Measurements were taken with a Mitutoyo digital vernier calliper (to the nearest 0.01 mm) and were converted to the nearest decimal of 0.1 mm. The following meristic and mensural characters were taken as per Mohapatra et al. (2023), with some additional characters: snout–vent length (SVL; from tip of snout to vent); axilla-to-groin length (AGL; measured from posterior edge of forelimb insertion to anterior edge of hind-limb insertion); body width (BW; maximum width of body); tail length (TL; from vent to tip of tail); tail width (TW; measured at widest point of tail); head length (HL; distance between retroarticular process of jaw and snout tip); head width (HW; maximum width of head); head depth (HD; maximum height of head from occiput to underside of jaws); forearm length (FL; from base of palm to elbow); crus length (CL; from base of heel to knee); eye diameter (ED; greatest diameter of orbit); interorbital distance (IO; shortest distance between left and right supraciliary scale rows); eye-to-nare distance (EN; distance between anterior-most point of eye and nostril); eye-to-snout distance (ES; distance between anterior-most point of eye and tip of snout); eye-to-ear distance (EE; distance from anterior edge of ear opening to posterior corner of eye); ear length (EL; longest dimension of ear); internarial distance (IN; distance between nares); mental length (ML; maximum length of mental scales); first postmental length (1st PML); first postmental contact region (1st PC); second postmental length (2nd PML); fourth finger length (LD4A); and fourth toe length (LD4P). Meristic data recorded were number of transverse ventral scale rows across midbody (MVSR); number of longitudinal ventral scales (between mental and cloaca, excluding the postmentals) (VS); number of subdigital lamellae under 1st finger (LamF1), 2nd finger (LamF2), 3rd finger (LamF3), 4th finger (LamF4), 5th finger (LamF5), 1st toe (LamT1), 2nd toe (LamT2), 3rd toe (LamT3), 4th toe (LamT4), 5th toe (LamT5); number of transverse rows of tubercles between occiput sinus and middle of sacrum or paravertebral tubercles (PVT); number of supralabials (SL) and infralabials (IL); dorsal tubercle rows (DTR); femoral pores (FP); and number of poreless scales between femoral pores (SBFP).

Molecular data

One sequence of the new species (holotype ZSI-R-27672) presented herein was published in the phylogenetic tree of Agarwal et al. (2019) and Mohapatra et al. (2023), and additional sequences were generated from two paratypes (ZSI-R-29247 and 29248) from Mandaragiri,

Angul, Odisha (Table 1) to validate the data. DNA was extracted using the DNeasy Blood and Tissue Kit (Qiagen, Hilden, Germany). We amplified the complete mitochondrial ND2 gene using primers L4437 and H5540 (Macey et al. 1997) with up to 1041 nucleotides, and sequencing was outsourced to Eurofins India Pvt. Ltd. (Hyderabad, India). The ND2 sequences for the *H. prashadi* group were downloaded from GenBank, which include most named Indian species and sister lineages from the Eastern Ghats, with *Hemidactylus hunae* Deraniyagala, 1937 and *Hemidactylus vanam* Chaitanya, Lajmi & Giri, 2018 used as outgroups (Table 1; after Giri et al. 2017; Mirza et al. 2017; Agarwal et al. 2019; Mohapatra et al. 2023). Sequence alignment was performed in MEGA v.12 (Kumar et al. 2024) using default settings. Uncorrected pairwise sequence divergence was calculated using the pairwise deletion option for members of the *H. kangerensis* complex within the *H. prashadi* group. Phylogenetic analysis was conducted on the unpartitioned dataset using the GTR + G + I model, with nodal support assessed via 1,000 bootstrap replicates.

Results

Phylogenetic analyses recovered three well-supported subclades within the *H. prashadi* group in the northern Eastern Ghats: the *H. sushilduttai*, *H. triedrus*, and *H. maculatus* subclades (Giri et al. 2017; Mirza et al. 2017; Agarwal et al. 2019; Mohapatra et al. 2023) (Fig. 2; BS > 95). The newly identified lineage falls within the *H. sushilduttai* subclade and is a sister to two lineages, one of which is *H. kangerensis*. Genetic analysis based on uncorrected ND2 p-distances indicates that the new lineage differs from its sister taxon, *H. sushilduttai*, by 13–16%, 12.5–15% from *H. kangerensis*, and from other members of the *H. prashadi* group by more than 18% (Table 2). Given its substantial genetic divergence, we herein describe this lineage as a new species.

Systematics

Hemidactylus kalinga sp. nov.

<https://zoobank.org/C67C70EB-0025-4B42-8DB8-88394E53ADAC>

Figs 2–6; Tables 3, 4

Holotype (Figs 3, 4). • ZSI-R-27672, adult male, Kalinga Ghati (20.1605°N, 84.4133°E; 746 m a.s.l.), Kandhamal District, Odisha State, India; collected by Pratyush P. Mohapatra in May 2016.

Paratypes (Fig. 5). • ZSI-R-28076, adult male, Barbara (19.8544°N, 85.0240°E; 156 m a.s.l.), Khordha District, Odisha State, India, collected by Pratyush P. Mohapatra and Sushil Kumar Dutta on May 2016; • ZSI-R-28932, adult male, Budhakhhol (19.8204°N, 84.8235°E; 268 m a.s.l.), Ganjam District, Odisha State, India, collected by Pratyush P. Mohapatra and Ashish K. Das (Jasmine P. and party) on 1 October 2021; • ZSI-R-29007, adult female, Barbara

Table 1. Sequences of the mitochondrial ND2 gene used in this study. Abbreviations for museum and voucher collections are as follows: ZSI, Zoological Survey of India; AK, Akshay Khandekar field series; AMB, Aaron Bauer field series; BNHS, Bombay Natural History Society, Mumbai; CES/ CES G, Centre for Ecological Sciences, Indian Institute of Science, Bengaluru, India; JB, Jon Boone private collection; NHM.OU, Natural History Museum, Department of Zoology, Osmania University; and NCBS, National Centre for Biological Sciences, Bangalore.

S.no	Species	GenBank accession	Voucher	Locality
1	<i>Hemidactylus kalinga</i> sp. nov.	PX577534	ZSI-R-29247	India, Odisha State, Angul District, Mandaragiri
2	<i>Hemidactylus kalinga</i> sp. nov.	PX577535	ZSI-R-29248	India, Odisha State, Angul District, Mandaragiri
3	<i>Hemidactylus kalinga</i> sp. nov.	MK569846	ZSI-R-27672	India, Odisha State, Kandhamal District, Kalinga Ghati
4	<i>Hemidactylus kangerensis</i>	MK569823	CES14184	India, Andhra Pradesh, Visakhapatnam , Sileru
5	<i>Hemidactylus kangerensis</i>	MK569822	CES14190	India, Andhra Pradesh, East Godavari, VR Puram
6	<i>Hemidactylus kangerensis</i>	MK569824	BNHS 2486	India, Chhattisgarh, Bastar, Kanger Valley
7	<i>Hemidactylus sushilduttai</i>	MK569852	CES11079/NCBS-AU157	India, Andhra Pradesh, Visakhapatnam, Simhachalam
8	<i>Hemidactylus paucifasciatus</i>	OQ595083	ZSI-R-28526	India, Odisha, Keonjhar, Anandapur, Gadachandi Temple
9	<i>Hemidactylus maculatus</i>	MK569829	AK064	India, Maharashtra, Raigad, Matheran
10	<i>Hemidactylus prashadi</i>	MK569843	CESG359	India, Maharashtra, Kolhapur, Patgaon
11	<i>Hemidactylus hunae</i>	HM559640	AMB7416	Sri Lanka, Pitakumbura
12	<i>Hemidactylus maculatus</i>	MK569826	CESG341	India, Maharashtra, Nashik, Nashik
13	<i>Hemidactylus maculatus</i>	MK569827	AK062	India, Maharashtra, Pune, Mulshi
14	<i>Hemidactylus</i> cf. <i>maculatus</i>	MK569832	AK041	India, Maharashtra, Ratnagiri, Guhagar
15	<i>Hemidactylus</i> cf. <i>maculatus</i>	MK569833	AK042	India, Maharashtra, Kolhapur, Amba
16	<i>Hemidactylus prashadi</i>	HM559643	JB30	India, pet-trade
17	<i>Hemidactylus prashadi</i>	HM559642	JB02	India, pet-trade
18	<i>Hemidactylus sahgali</i>	MG742362	NCBS_AU709	India, Maharashtra, Pune, Saswad
19	<i>Hemidactylus siva</i>	MK569845	NHM.OU.REP.H	India, Karnataka, Bellary, Hampi
20	<i>Hemidactylus subtriedrus</i>	MH666065	NCBS-AU703	India, Andhra Pradesh, Nellore, Nellore
21	<i>Hemidactylus subtriedrus</i>	MH454771	CES13191	India, Maharashtra, Solapur, Barshi
22	<i>Hemidactylus sahgali</i>	HM559649	JB09	India, pet-trade
23	<i>Hemidactylus sahgali</i>	HM559650	JB08	Pakistan, pet-trade
24	<i>Hemidactylus vanam</i>	MK569853	CESG392	India, Tamil Nadu, Madurai, Saptur
25	<i>Hemidactylus vanam</i>	MK569854	CESG393	India, Tamil Nadu, Madurai, Saptur
26	<i>Hemidactylus whitakeri</i>	MH666067	NCBS-AU720	India, Karnataka, Bangalore Urban, GKVK chamba
27	<i>Hemidactylus whitakeri</i>	MH666066	NCBS-AU713	India, Kodalgurki village, Bangalore rural
28	<i>Hemidactylus paucifasciatus</i>	MK569847	CES15248	India, Odisha, Keonjhar, Anandapur, Gadachandi Temple

Table 2. Pairwise uncorrected ND2 sequence divergence (p-distances), in percentage, among the *Hemidactylus prashadi* clade in South Asia and the outgroups.

S. No	Species	1	2	3	4	5	6	7	8	9	10	11	12	13
1	<i>Hemidactylus kalinga</i> sp. nov.	1–3												
2	<i>Hemidactylus kangerensis</i>	12.5–15	1–1.5											
3	<i>Hemidactylus sushilduttai</i>	13–16	11–12.2	0.0										
4	<i>Hemidactylus paucifasciatus</i>	18–19.5	19.7–20	21.8–22	0.0									
5	<i>Hemidactylus</i> cf. <i>maculatus</i>	18–19.5	20–22	22–22.4	21–21.4	0.0								
6	<i>Hemidactylus maculatus</i>	19.5–20	19.9–22.5	23–24.5	19.5–21.5	9	1.2–2.4							
7	<i>Hemidactylus siva</i>	19–19.5	20.5–21	20.3	21.9–22	20.6	19–19.8	0.0						
8	<i>Hemidactylus whitakeri</i>	22.8–24.5	22.9–24	25.5–25.8	18.5–20	19.5–21.5	19.8–21.9	20.4	0.5					
9	<i>Hemidactylus triedrus</i>	20–23.5	23–24	25.4	18.8–19	20.5–21	21–22.3	19.4	18.8–19.5	0.0				
10	<i>Hemidactylus sahgali</i>	21.5–24.5	22.5–23.6	25.3–25.5	18.3–18.9	20–21.5	20–21.5	21–22.5	13–15	19.5–20	0.5–1			
11	<i>Hemidactylus prashadi</i>	20–21.5	22.8–24	25.6–25.8	25–26.5	21.5–22	22.5–24	20.5	29.5–31.5	27.2–27.8	28–29.5	0.5–1		
12	<i>Hemidactylus hunae</i>	23.5–27.5	25–26.2	25.9	27.5–29	25.2–25.5	26.5–27.2	24.5	29–31	31.5	28.8–29.6	27.2–28.9	0.0	
13	<i>Hemidactylus vanam</i>	28–29.5	28–30	29.5–30.8	32.3–33.3	31.4–32.7	29.8–32.5	27.9	30.5–32.5	30	28.5–29.5	29.3–30	32.6	0.0

(19.8544°N, 85.0240°E; 156 m a.s.l.), Khordha District, Odisha State, India, collected by Pratyush P. Mohapatra (Jasmine P. & party) on 28 September 2021; • ZSI-R-29247, 29248, adult females, Mandaragiri (20.7997°N, 85.0349°E; 421 m a.s.l.), Angul District, Odisha State, India, collected by Pratyush P. Mohapatra and party on 14 December 2024.

Suggested common English name. Kalinga rock gecko.

Etymology. The specific epithet is a toponym for the Kalinga Ghati, the Eastern Ghats hill ranges in the Kandhamal District of Odisha, and the type locality of the species. Furthermore, the present known distribution range of the species is within the historical “Kalinga Kingdom”, comprising present-day south Odisha. The specific name is a noun in apposition to the generic name.

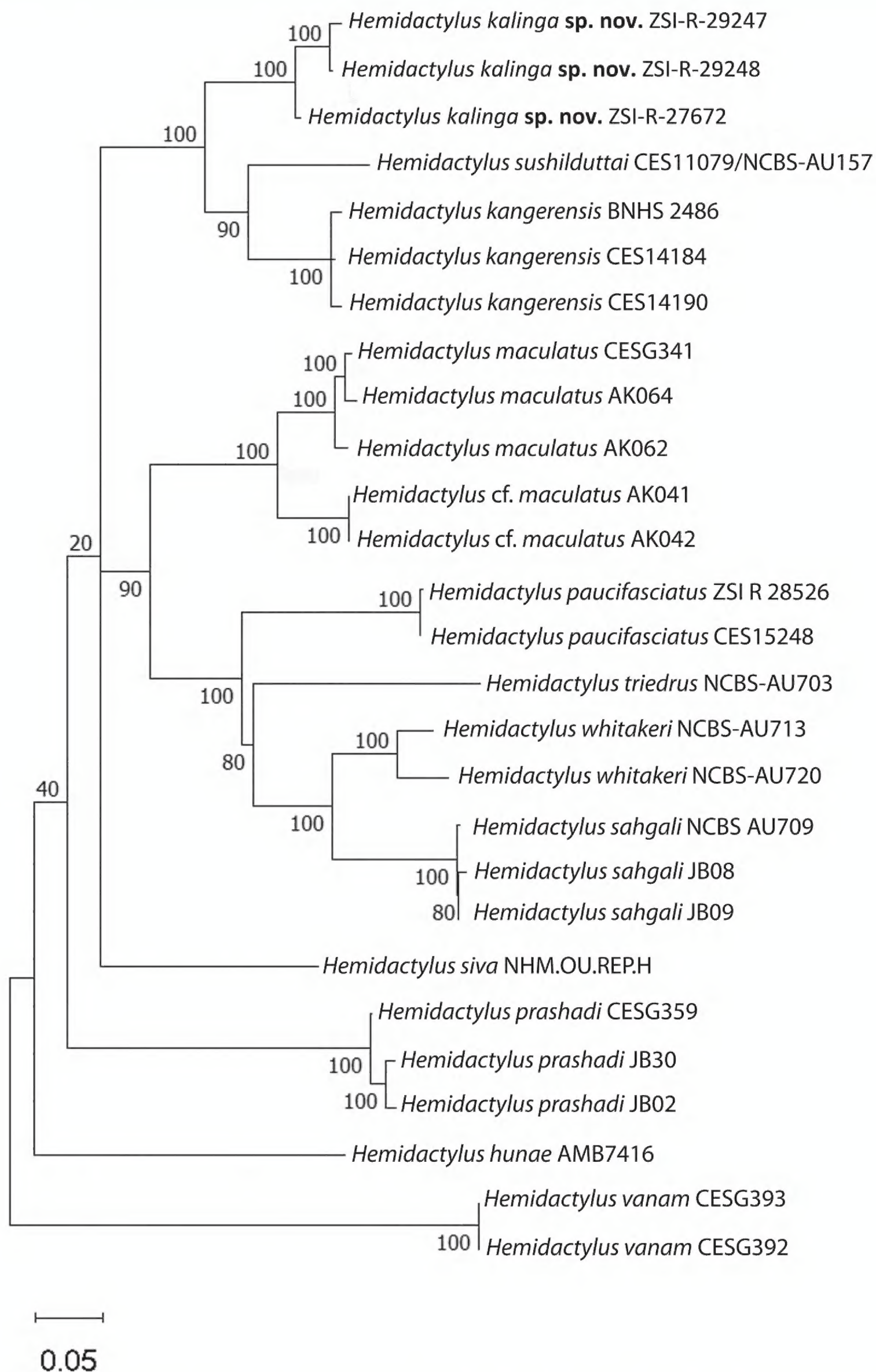


Figure 2. Maximum-likelihood consensus tree based on the mitochondrial ND2 gene of the *Hemidactylus prashadi* clade and the outgroups. Numbers by the nodes indicate ML bootstrap support values.

Diagnosis. A large-sized and tuberculated *Hemidactylus*, SVL up to 105.4 mm (n = 6). Dorsal pholidosis heterogeneous, composed of subcircular granular scales intermixed with enlarged, fairly regularly arranged, strongly keeled, conical tubercles in 15–19 longitudinal

rows, extending from occiput to tail base, that are heterogeneous in shape and size; enlarged tubercles on the two most medial parasagittal rows smaller, 27–30 tubercles in paravertebral rows; those on dorsolateral aspect of flank largest, gradually decreasing in size downwards,

last two rows on flank marginally larger or equal to medial parasagittal rows, weakly keeled. Ventrolateral folds indistinct; about 32–35 scale rows across the belly. Digits with enlarged scansors, lamellae in straight transverse series, all divided except the apical and 1–3 basal lamellae, 9–12 lamellae beneath first digit and 12–14 beneath fourth digit of manus and pes. Males with 22–26 femoral pores on each side separated by five poreless scales. Tail with much enlarged, strongly keeled, conical tubercles forming whorls; median row of subcaudal plates large, covering almost entire portion of the tail; single postcloacal spur of unequal size on each side that are smooth and much smaller than dorsal tubercles at mid-body. Dorsal coloration rusty-brown with four transversely arranged light bands, edged with black or dark brown, between the occiput and sacrum; head lighter than body in life, with a narrow lighted collar edged by dark brown that is continuous with the post-ocular marking.

Description of the holotype. (Figs 3, 4) The male holotype is in good condition with a slightly curved tail. The head is slightly bent to the right. The tail is also bent to the right and mostly (nearly 80%) regenerated. There is a 23 mm long incision in the ventral region (for tissue collection).

A large-bodied gecko (SVL 103.0 mm) with a large head (HL/SVL ratio 0.3), slightly elongate (HW/HL ratio 0.8), not strongly depressed (HH/HL ratio 0.5), distinct from the neck. Loreal region slightly inflated, canthus ro-

stralis not prominent. Snout short (ES/HL ratio 0.4); much longer than eye diameter (ED/ES ratio 0.6); scales on snout, canthus rostralis granular, 2 to 3 times larger than those on interorbital and occipital region, occipital region has intermixed enlarged, keeled, pointed tubercles, which are 3 to 4 times larger than adjacent granules. Eye small (OD/HL ratio 0.3); pupil vertical with serrated margins; supraciliaries small, pointed, those at the anterior end of orbit slightly larger, posterior half with smaller spinose scales. Ear opening oval (greatest height 2.3 mm); eye to ear distance slightly greater than diameter of eye (EE/OD ratio 1.1). Rostral incompletely divided dorsally by weakly developed rostral groove; internasals separated by a single small scale, one supranasal and one postnasal on each side, all subequal; rostral in contact with supralabial I, nostril, internasals and scale separating the internasals; nostrils large (0.7 mm), subcircular, each surrounded by rostral, supralabial I, postnasal, supranasal and internasal; 5 to 6 rows of scales separate orbit from supralabials, single row of enlarged elongate scales bordering supralabials. Mental triangular, broader (4.4 mm) than high (3.7 mm), two pairs of postmentals, inner pair slightly shorter (3.6 mm) than mental and broadly in contact with each other (1.7 mm); outer post mental fairly smaller than inner post mental (2.2 mm), undivided. Inner postmentals bordered by mental, infralabial I, outer postmentals and 4 gular scales; outer postmentals bordered by inner



Figure 3. *Hemidactylus kalinga* sp. nov. (holotype, ZSI-R-27672) showing the dorsal and ventral sides.

postmental, infralabial I and II and 8 gular scales on either side, of which outer row continues as a single row of enlarged scales below infralabials. About 2–7 rows of scales below infralabials III to VIII are enlarged and weakly imbricate. Supralabials (to midorbital position) 9 (right), 10 (left); supralabials (to angle of jaw) 13; supralabials (below orbit) 6; infralabials (to angle of jaw) 10.

Body relatively stout, not elongate (TRL/SVL ratio 0.4), with indistinct ventrolateral folds. Dorsal pholidosis heterogeneous, composed of conical, granular scales intermixed with enlarged, relatively regularly arranged, longitudinal rows of 17 trihedral, strongly keeled tubercles at midbody, extending from occiput onto the tail, each enlarged tubercle roughly 4–7 times longer than

adjacent granules, surrounded by 16–20 small granules, 2–4 granules separate adjacent enlarged tubercles; 28 rows of para-vertebral tubercles between occiput sinus and middle of sacrum; enlarged tubercles similar in size except those on most medial rows less than half the size of adjacent tubercle; shape of enlarged tubercles on back homogenous except those on flanks conical; enlarged tubercles on nape slightly smaller and more conical than those of back; tubercles on occipital and temporal region much smaller, strongly pointed. Ventral scales larger than dorsal granules, smooth, imbricate, slightly larger on femoral and largest on precloacal region; midbody scale rows across belly 32; longitudinal ventral scales from mental to cloaca 160; gular region with granular scales

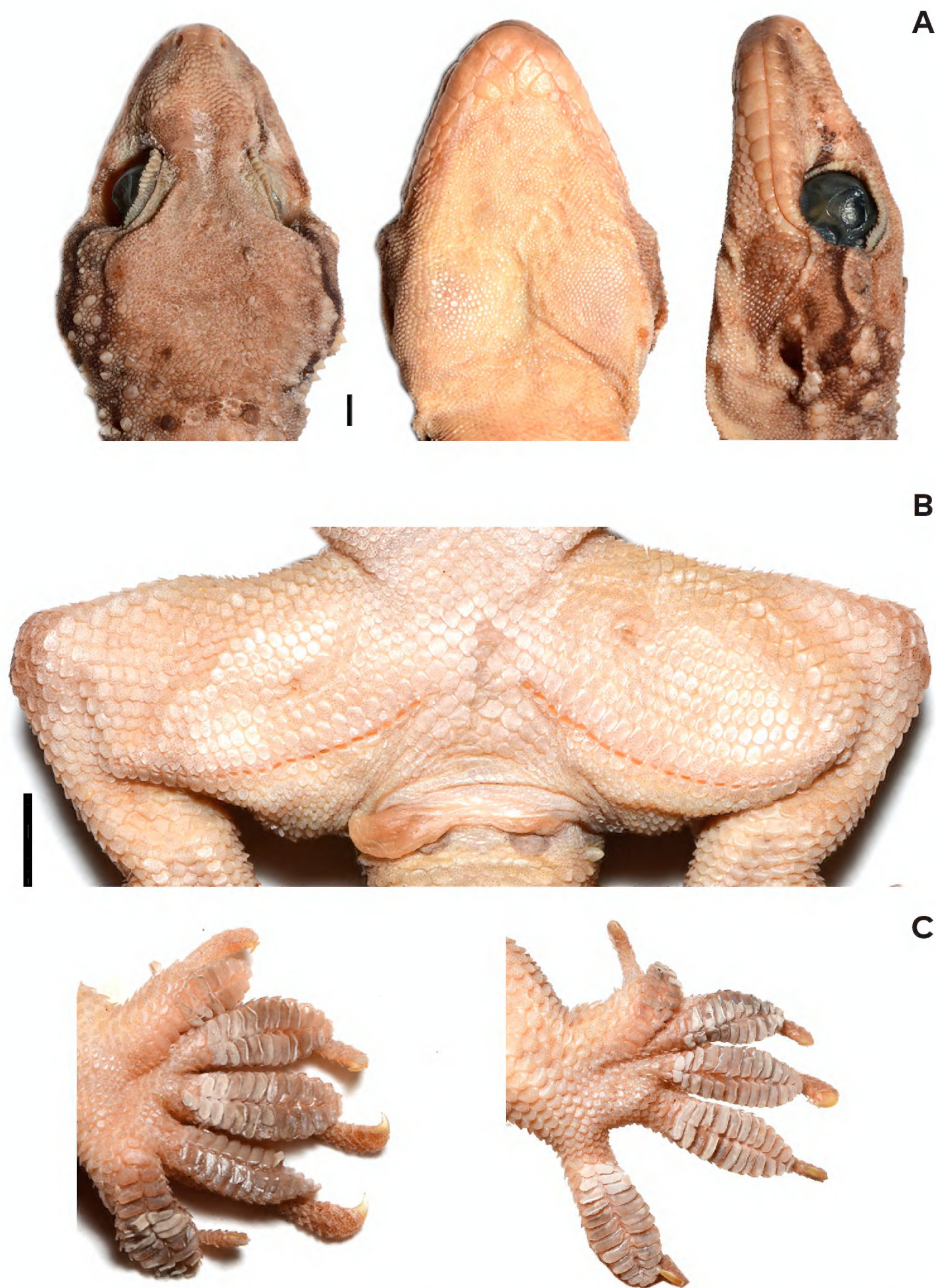


Figure 4. *Hemidactylus kalinga* sp. nov. (holotype, ZSI-R-27672) **A.** Dorsal, ventral, and lateral view of head; **B.** View of cloacal region showing femoral pores; and **C.** Digits showing lamellae. Scale bar: 10 mm.

that are smaller than ventrals; 7 transverse ventral scales present within the eye diameter.

Scales on the palm and sole smooth, granular, rounded; dorsal aspect of manus and pes heterogenous, granular with densely packed enlarged tubercles, upper arm with a few granular scales which are larger than granules on dorsum intermixed with much larger tubercles; dorsal aspect of forearm predominantly bearing much larger, flattened, strongly keeled tubercles; scales on elbow are strongly keeled and conical, slightly smaller than the enlarged tubercles on the upper arm; those on dorsal aspect of thigh heterogeneous with a few granular scales which are similar to those on dorsum, intermixed with much larger trihedral tubercles which are slightly larger than enlarged dorsal tubercles; tubercles on the back of the thigh much smaller, conical and sparsely spaced; large trihedral tubercles on dorsal aspect of shank slightly smaller than those on dorsum of thigh, intermixed with a few granular scales; scales on knee are strongly keeled and conical, ~ 2 times larger than adjacent granules. 22 (left)/23 (right) femoral pores in slightly enlarged row of scales, separated medially by five poreless scales. Fore- and hind limbs relatively short, stout; forearm short (FL/SVL ratio 0.1); tibia short (CL/SVL ratio 0.2); digits moderately short, strongly clawed; all digits of manus and digits I–IV of pes indistinctly webbed; terminal phalanx of all digits curved, arising angularly from distal portion of expanded lamellar pad or scansor, half or more than half as long as associated toepad; lamellae beneath each toe in straight transverse series, divided except for three to four basal scansors on digit I and single distal on all digits and some single basal ones too; scansors from proximal most at least twice diameter of palmar scales to distal most single scansor: 10-12-12-13-11 (right manus), 11-12-13-13-12 (left manus), 10-13-14-14-12 (right pes), 10-13-14-13-13 (left pes). Relative length of digits (measurements in mm in parentheses): IV (10.31) > III (9.77) > II (9.36) > V (8.64) > I (8.06) (left manus); III (11.04) > IV (10.90) > II (10.27) > V (10.06) > I (8.34) (left pes). Tail depressed, flat beneath, verticillate, with well-defined median furrow; length of the regenerated tail slightly shorter than snout-vent length (TL/SVL ratio <1.0); scales on the tail subimbricate, slightly conical and keeled, larger than granules on dorsum, with a series of much enlarged, strongly pointed and keeled conical tubercles, lateral row on both sides slightly elongated and weakly keeled; ventral scales enlarged, imbricate, median row (subcaudal plates) covering almost entire base of the tail after five rows of smaller scales, with two rows of larger pointed, smooth, imbricate scales on lateral aspects.

Colouration. Body colour olive brown with four distinct bands, bordered with dark brown wavy lines. The first band is on the shoulder, the second after the axilla, the third band is posterior to the mid-body and the fourth appears at the groin. On the tail, a band, similar to the body, appears at the base of the tail. Head and limbs same colour as the body. Toes and ankles have light banding patterns. A dark post-ocular line passes at the temporal

region just above the tympanum and approaches towards the nape forming an indistinct border line on the head. Ventral side is off-white or light-brown. In preservative, the ground colour is faded, but the patterns are visible.

Variations. Mensural data for the type series is given in Table 3 and Fig. 5. There are five paratypes (two males and three females) ranging in SVL from 88.5 mm to 105.4 mm. They agree with the description of the holotype in most of the morphological characters except as follows: infralabials 9–11; scales across midbody 33–35; dorsal tubercle rows 15–19; longitudinal ventral scales 151–174; femoral pores 23–26. Colourations of paratypes are variable from that of the holotype. The paratype from Budhakhol (ZSI-R-28932) is lighter in colour, without any prominent bands on the body. Uncollected juveniles are of darker colouration with more pronounced bands on the body and tail (Fig. 6A).

Distribution and natural history. *Hemidactylus kalinga* sp. nov. is endemic to the Eastern Highlands biogeographic province of the Deccan Peninsula biogeographic zone (Rodgers et al. 2000) and has been recorded from the forest tracts in the northern Eastern Ghats range of Odisha. The northernmost distribution is north of the River Mahanadi, within 50 km of the river, which is also considered a part of the Eastern Ghats Mobile Belt. This species was found to be common in the rocky outcrops in the Kandhamal hills of Kandhamal district, in the Barbara Reserve Forest of Khurdha district, in the Mandaragiri hills of Angul district, and also in the Bhanjanagar tracts of Ganjam district. This species is most likely distributed in the Lakhari Valley and Kotagarh Wildlife Sanctuaries of the Ganjam and Kandhamal districts, respectively, and has also been observed in the Balangir district. Although there are several instances in which similar-looking, large-bodied *Hemidactylus* sp. have been encountered in Ganjam district and further south in Odisha in Gajapati, Rayagada, Koraput, Kalahandi, and Phulbani districts; in central Odisha in Cuttack and Nayagarh districts; and in Sambalpur district of western Odisha, we refrain from assigning them to this species, as we are not yet certain about the taxonomic identity of those populations. These will be dealt with in subsequent works.

The new species is predominantly found in dry and moist deciduous forests with rocky outcrops (Fig. 7A, B). The areas in which this species occurs are at mid-elevations (156–746 m a.s.l.), and it prefers large boulders in cooler areas, covered with large trees or situated in riparian zones. The type locality is a riparian forest near a temple at a ghat section just adjacent to NH 157. Within its distribution range, the new species is sympatric with other geckos such as *Calodactylodes aureus* (Beddome, 1870), *Cyrtodactylus nebulosus* (Beddome, 1870), *Hemidactylus flaviviridis* Ruppell, 1835, *H. frenatus* Duméril & Bibron, 1836, *H. leschenaultii* Duméril & Bibron, 1836, and *H. parvimaculatus* Deraniyagala, 1953. Based on our observations, this species was found to be feeding on various arthropods and their larvae. One individual was observed feeding on the mole cricket *Gryllotalpa africana* (Palisot

Table 3. Morphological and meristic data for type specimens of *Hemidactylus kalinga* sp. nov.

Specimen No.	ZSI-R-27672 (Holotype)	ZSI-R-28076 (Paratype-1)	ZSI-R-28932 (Paratype-2)	ZSI-R-29007 (Paratype-3)	ZSI-R-29247 (Paratype-4)	ZSI-R-29248 (Paratype-5)
Sex	M	M	M	F	F	F
SVL	103.0	103.6	99.1	103.5	105.4	88.5
AGL	40.3	43.3	45.3	46.3	48.0	37.3
BW	22.2	26.3	22.0	22.6	30.6	20.5
TL	102.1	73.5	90.4	96.6	*	93.5
TW	12.9	12.9	12.5	14.3	18.6	11.1
HL	29.1	29.9	28.8	29.6	32.8	25.2
HW	23.5	24.0	22.3	22.2	24.6	19.4
HD	13.8	13.9	14.4	13.4	16.3	12.9
FL	14.5	14.5	14.5	14.9	14.6	11.4
CL	16.2	14.9	14.1	14.4	14.6	12.5
ED	7.3	6.9	5.7	7.0	5.9	5.7
IO	8.2	8.8	9.2	9.7	11.1	8.0
EN	9.2	10.1	9.2	10.5	10.7	8.1
ES	12.2	12.9	11.5	13.0	12.0	9.9
EE	8.3	8.2	8.5	8.1	8.3	6.5
EL	2.3	2.8	3.5	2.4	3.1	3.1
IN	2.6	3.1	3.2	3.3	3.9	2.4
ML	3.7	3.3	3.7	3.7	4.1	3.6
1 st PML	3.6	3.5	3.1	3.6	3.6	3.1
1 st PC	1.7	1.7	1.5	1.6	1.2	1.4
2 nd PML	2.2	2.3	2.1	2.6	2.3	1.9
LD4A	9.5	9.4	9.2	8.4	9.6	7.5
LD4P	10.1	9.3	9.5	10.0	9.8	7.6
MVSR	32	35	35	33	35	33
VS	160	151	169	173	170	174
LamF1 (L/R)	11/10	11/10	11/10	12/12	12/11	12/12
LamF2 (L/R)	12/12	13/12	12/12	13/12	12/12	13/13
LamF3(L/R)	13/12	13/13	13/13	13/12	13/13	13/13
LamF4 (L/R)	13/13	14/12	12/13	13/12	14/13	14/14
LamF5 (L/R)	12/11	12/12	12/11	13/13	13/13	13/13
LamT1 (L/R)	10/10	10/11	10/9	10/10	10/10	10/10
LamT2 (L/R)	13/13	13/13	12/12	13/13	13/13	13/13
LamT3 (L/R)	14/14	14/13	13/13	13/13	13/13	14/14
LamT4 (L/R)	13/14	13/13	12/13	13/13	13/13	14/14
LamT5 (L/R)	13/12	12/13	11/11	12/12	12/12	14/14
FP (L/R)	22/23	24/26	25/23	-	-	-
SBFP	5	5	5	-	-	-
SL (L/R)	13/13	13/12	11/11	13/11	11/13	12/11
SL below eye (L/R)	10/10	10/9	9/10	11/9	9/10	10/9
IL (L/R)	10/10	10/11	9/10	10/10	10/10	9/9
DTR	17	19	15	15	18	18
PVT	28	30	29	28	27	27

de Beauvois, 1805) in the Budhakhol area, locating the movement of the insect on the ground (Fig. 6B).

Comparison with members of the *H. prashadi* group

The new species was phylogenetically recovered as part of the *prashadi* group and can be morphologically assigned to the group based on its large size and prominent dorsal tuberculation. We therefore restrict comparisons to other members of the *prashadi* group. *Hemidactylus kalinga* sp. nov. can be easily distinguished from other members of the *prashadi* group (except *H. sushilduttai* and

H. kangerensis) by having heterogeneous dorsal scales with enlarged tubercles (versus homogenous dorsal pholidosis of imbricate scales, lacking enlarged tubercles in *H. scabriceps* (Annandale, 1906)), composed of granular scales intermixed with enlarged, fairly regularly arranged, strongly keeled, conical tubercles, 15–19 DTR; (versus composed of granular scales intermixed with enlarged, rounded, weakly-keeled tubercles, 18–20 DTR in *H. aar-onbaueri*; composed of granular scales intermixed with enlarged, fairly regularly arranged, strongly keeled, conical tubercles — 18–20 DTR in *H. acanthopholis* Mirza & Sanap, 2014; 12–14 DTR in *H. kimbulae* Amarasinghe, Karunarathna, Campbell, Madawala & de Silva, 2021; 20–24 DTR in *H. maculatus*; 22–24 DTR in *H. paaragowli*

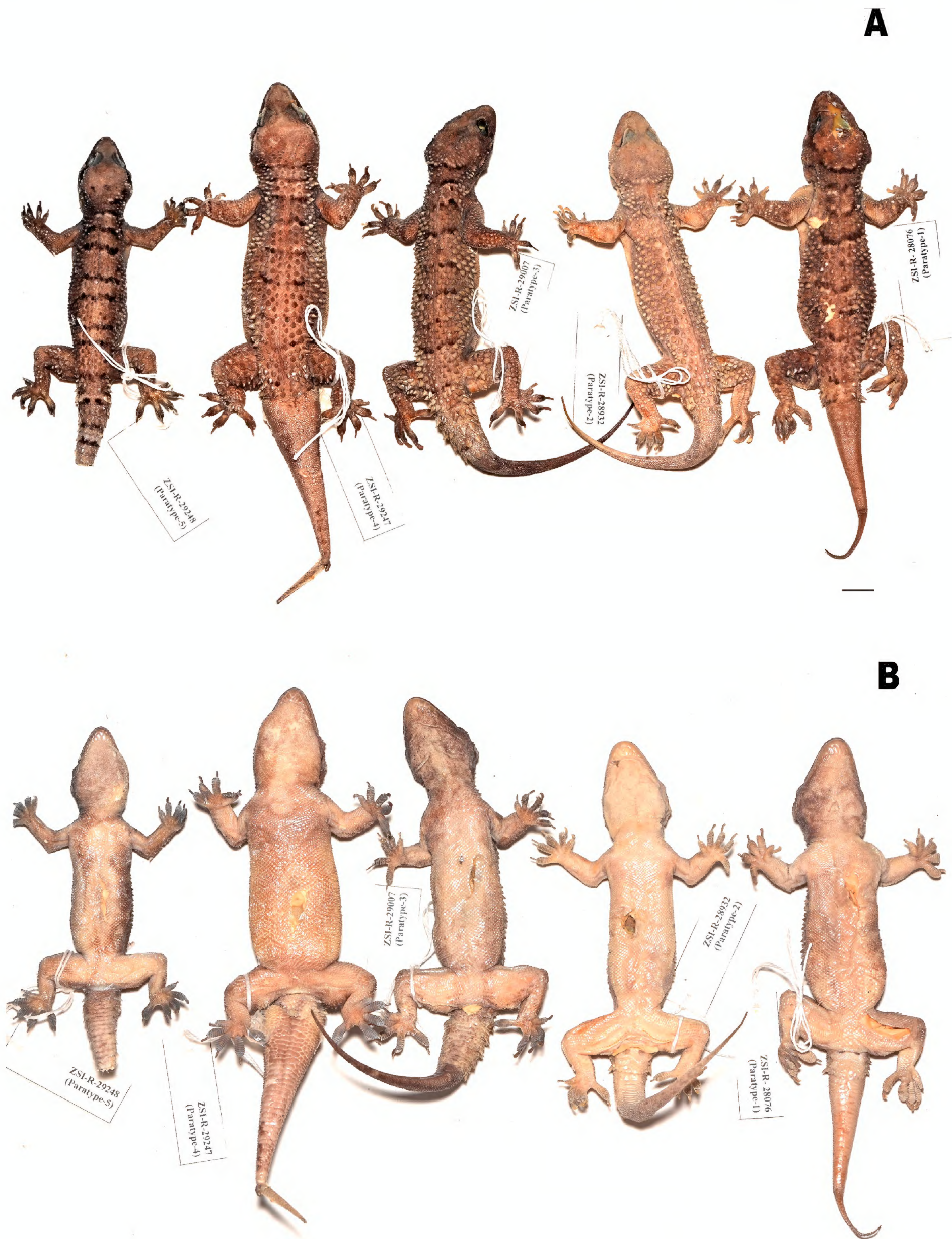


Figure 5. Full-body view of all the paratypes of *Hemidactylus kalinga* sp. nov. **A.** Dorsal; **B.** Ventral. Scale bar: 20 mm.

Srikanthan, Swamy, Mohan & Pal, 2018; 16–18 DTR in *H. paucifasciatus*; 14–16 DTR in *H. prashadi*; 19–20 DTR in *H. triedrus*); males with 22–26 FP and five SBFP (versus 19 FP and six SBFP in *H. aaronbaueri*; 19–21 FP and

13–14 SBFP in *H. acanthopholis*; 15–19 FP and 2–4 SBFP in *H. depressus* Gray, 1842; 24–30 FP and 2–4 SBFP in *H. easai* Das, Pal, Siddarth, Palot, Deepak & Narayanan, 2022; 23–28 FP and 1–3 SBFP in *H. graniticulus* Agarwal,

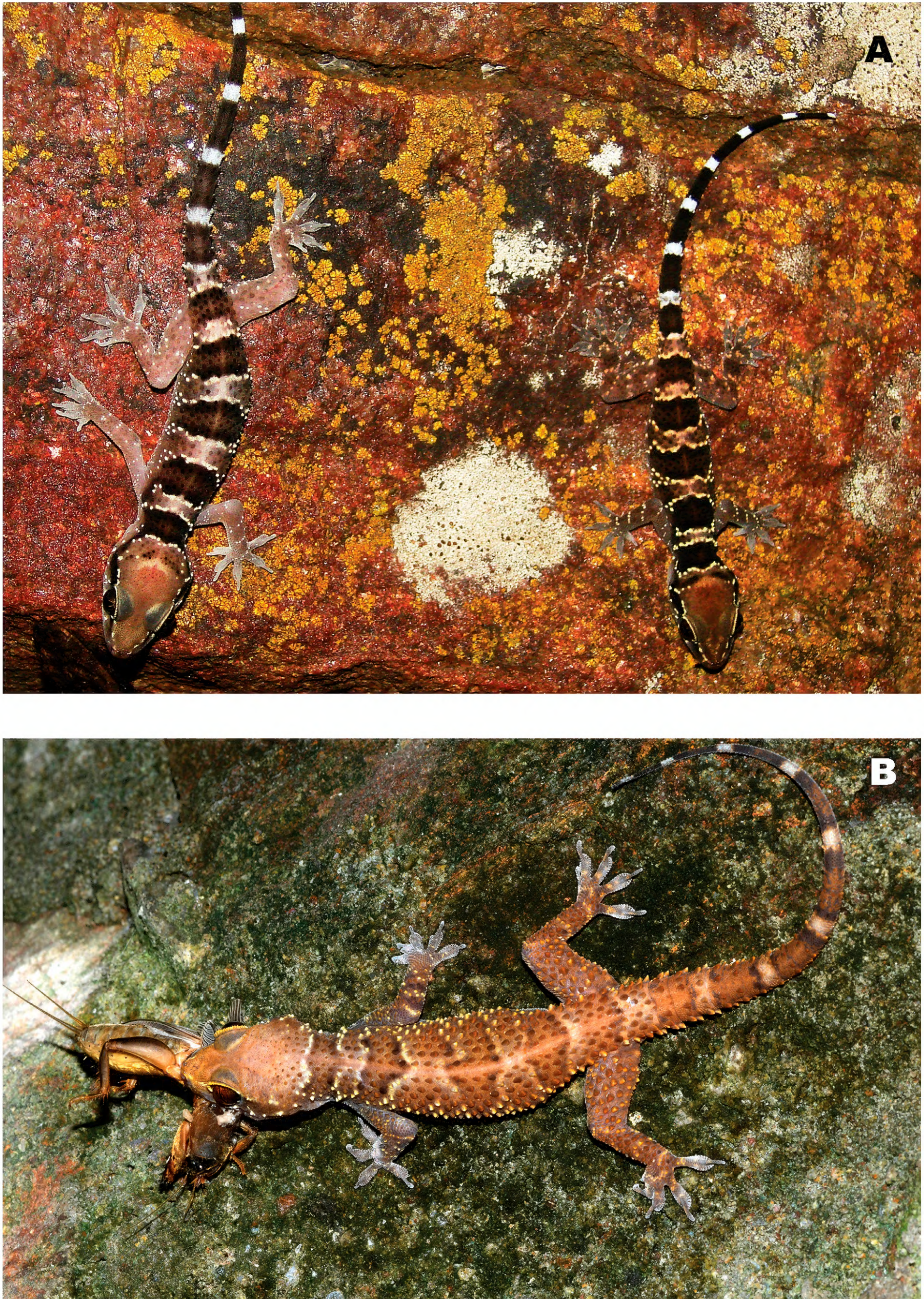


Figure 6. Live uncollected specimen of *Hemidactylus kalinga* sp. nov. **A.** Juveniles showing variant colouration; **B.** An individual preying on *Gryllotalpa africana*.



Figure 7. Habitat of *Hemidactylus kalinga* sp. nov. (A) type locality in Kalinga Ghati, Odisha; (B) paratype locality in Budhakhol, Odisha.

Table 4. Comparative key morphological characters of *Hemidactylus kalinga* sp. nov. with *H. sushilduttai* and *H. kangerensis*.

Species Name	DTR	MVSR	FP	SBFP	2 nd PML compared to 1 st PML	IL touching 1 st postmental	IL touching 2 nd postmental	Post-cloacal spur
<i>H. kalinga</i> sp. nov.	15–19	32–35	22–26	5	more than half	I	I & II	1
<i>H. sushilduttai</i>	16–17	30–33	20–23	3–6	less than half	I & II	II	2
<i>H. kangerensis</i>	18–20	28–30	18–21	4	less than half	I	I & II	3

Giri & Bauer, 2011; 14–15 FP and 11 SBFP in *H. hegdei* Pal & Mirza, 2022; 22–24 FP and 3–6 SBFP in *H. hunae*; 21–24 FP and 5–7 SBFP in *H. kimbulae*; 21–25 FP and two–three SBFP in *H. kolliensis* Agarwal, Bauer, Giri & Khandekar, 2019; 16–19 FP and 5–9 SBFP in *H. maculatus*; 10–12 FP and 16–18 SBFP in *H. paaragowli*; 12–13 FP and 3–4 SBFP in *H. paucifasciatus*; 17–20 FP and 1–3 SBFP in *H. pieresii* Kelaart, 1852; 17–20 FP and three SBFP in *H. prashadi*; 16–18 FP and 13–15 SBFP in *H. sirumalaiensis* Khandekar, Thackeray, Pawar & Agarwal, 2020; 17–18 FP and five SBFP in *H. siva*; 17–18 FP and seven SBFP in *H. tamhiniensis*; 7–9 FP and 1–3 SBFP in *H. triedrus*; 17–22 FP and 10–11 SBFP in *H. vanam*; 7–8 FP and three SBFP in *H. whitakeri*; FP absent, only precloacal pores present in *H. scabriceps*); 32–35 MVSR (versus 41–43 MVSR in *H. aaronbaueri*; 35–40 MVSR in *H. acanthopholis*; 28–36 MVSR in *H. depressus*; 41–42 MVSR in *H. easai*; 40–46 MVSR in *H. graniticolus*; 32–34 MVSR in *H. hegdei* and *H. kolliensis*; 36–39 MVSR in *H. kimbulae*; 28–34 MVSR in *H. maculatus*; 33–39 MVSR in *H. paaragowli*; 29–31 MVSR in *H. paucifasciatus*; 32–39 MVSR in *H. pieresii*; 36–38 MVSR in *H. sirumalaiensis*; 54–59 MVSR in *H. tamhiniensis*; and 34–40 MVSR in *H. vanam*).

Hemidactylus kalinga sp. nov. is most closely related to *H. sushilduttai* and *H. kangerensis*. A comparison among these three species has been provided in Table 4.

Discussion

Hemidactylus kalinga sp. nov. is the second endemic *Hemidactylus* from Odisha after *H. paucifasciatus* and the fourth endemic reptile from the state. The Eastern Ghats hill ranges are home to many endemic lizards, such as *Hemidactylus sushilduttai*, *H. kangerensis*, *Hemiphyllodactylus minimus* Mohapatra, Khandekar, Dutta, Mahapatra & Agarwal, 2020, *Hemip. arakuensis* Agarwal, Khandekar, Giri, Ramakrishnan & Karanth, 2019, *Cyrtodactylus jey-porensis* (Beddome, 1878), and *Calodactylodes aureus* (Beddome, 1870) of the family Gekkonidae; *Eutropis ashwamedhi* (Sharma, 1969), *E. nagarjuni* (Sharma, 1969), *Sepsophis punctatus* Beddome, 1870, *Barkudia insularis* Annandale, 1917, and *B. melanosticta* (Schneider, 1801) of the family Scincidae; and *Eublepharus pictus* Mirza & Gnaneswar, 2022, of the family Eublepharidae.

The *H. prashadi* clade is the most diverse clade, currently represented by 23 species distributed across India (Agarwal et al. 2019; Khandekar et al. 2021; Das et al. 2022; Pal and Mirza 2022; Mohapatra et al. 2023; Sayyed

et al. 2023). The description of this new species shows the need for more intensive taxonomic work to resolve species complexes. In the *H. prashadi* clade, several complexes still require further study.

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